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ABSTRACT

Whether there is a difference in job satisfaction, self-assessed knowledge of teaching, and ratings of the quality of teacher education programs for graduates of elementary teacher education programs and secondary teacher education programs was studied using the Teacher Education Follow-up Scale of the National Database for Teacher Education Follow-up Studies. Fourteen teacher preparation institutions participated in the follow-up study, although not all used all 4 subscales of the followup instrument. Sample sizes for each subscale ranged from 2,785 to 3,930. Analyses, which included mulitivariate analysis of variance, suggest that there is a difference between graduates of elementary teaching programs and graduates of secondary education programs. Job satisfaction and assessment of program quality were higher for graduates of elementary teaching preparation programs. These results have ramifications for the use and interpretation of data from teacher followups. (Contains two figures, three tables, and nine references.) (SLD)

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Determining the Multivariate Assumptions of a Four Dimensional Instrument Designed to Follow-up Elementary and Secondary Level Graduates of Multiple Teacher Education Institutions

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Objective:

The National Database (NDB) for Teacher Education Follow-up Studies is a compilation of data from various teacher preparation institutions across the United States. The Teacher Education Follow-up Scale contains a total of 49 items measuring four different subscales: Knowledge of Teacher (Knowledge), Skills of Teacher (Skills), Job Satisfaction (Job Satisfaction), and Quality of the Program (Program Quality). The number of specific items for defining these subscales were 13, 22, 7 and 7 respectively. The purpose of this study was to determine whether there was a difference between graduates in an elementary teacher education program and graduates in a secondary teacher education programs with respect to their rating on job satisfaction, their rating on knowledge of teaching, their rating on skill of teaching, and their rating on quality of the program.

Literature Review:

Under the press of accountability within institutions and by accreditation agencies, there has been renewed interest in program evaluation, and follow-up studies of graduates have increased. Follow-up studies are becoming more of an essential part of the evaluation of the teacher education programs. Seventy five percent of teacher education programs use follow-up surveys to get an indication of student satisfaction, program quality and skill preparation (Ayres, 1989).

Multivariate analysis of variance (MANOVA) techniques are routinely used in a variety of disciplines such as agriculture, anthropology, biological sciences, business, econometrics, education, engineering, marketing, medicine, psychology, and sociology.

The MANOVA model is a natural generalization of univariate analysis of variance (ANOVA). That is, two or more possibly correlated dependent variables are simultaneously modeled as the linear functions of the same set of independent variables (Khattree, R., and Naik, D., 1995).

Before applying any statistical techniques, it is crucial to verify if the data at hand satisfy the underlying distributional assumptions. For most multivariate analyses, it is thus very important that the data indeed follow the multivariate normal, if not exactly at least approximately (Khattree, R., and Naik, D., 1995). There are many possibilities for departure from multivariate normality and no single procedure is likely to be robust with respect to all such departures from the multivariate assumption (Mardia, K. V., 1980). This assumption is generally checked by Chi-square Q-Q plots. Violations of this assumption have only a very small effect on the type I error rate (Rummel, 1970; Stevens, 1986).

Homogeneity of variance-covariance matrices is another important assumption for MANOVA. This is the multivariate extension of the *homogeneity of variance* assumption of univariate ANOVA. The power of the test tends to be attenuated when the homogeneity assumption is violated (Stevens, 1986). It is strongly recommended that some appropriate tests for the homogeneity of the variance-covariance matrices be applied to the data prior to performing any multivariate analysis variance (Khattree, R., and Naik, D., 1995).

Data Source and Methodology:

A total of fourteen teacher preparation institutions participated in the follow-up studies, but not all four subscales were used by these institutions. The data were collected from these participating institutions during the 1991-1997 school years. The sample sizes for four different subscales, Job Satisfaction, Knowledge, Skills, and Quality were 2785, 3788, 3925 and 3930 respectively. The range for scale values for each item on the Knowledge subscale goes from a low score of one (negative) to a high of seven (positive); the Skills subscale goes from a low score of one (negative) to a high of three (strong); the Job Satisfaction subscale goes from a low score of one (negative) to a high of seven (positive); and, the Quality subscale goes from a low of one (weak) to a high of three (strong). In order to create a unique sample size, data were used only from those institutions that provided responses to all 49 items. To take care of the missing values, a listwise deletion method was used prior to apply the analyses techniques reducing the sample size to 1498.

The following three steps were used to complete the methodology of the intended study:

Step 1: Scores were generated for four different subscales by calculating the mean of corresponding items of each subscale.

Step 2: The assumption of *multivariate normality* was assessed for the subscale scores by Chi-square plots. The assumption of *homogeneity of variance-covariance matrices* was tested by applying PROC DISCRIM in the SAS system.

Step 3: Then, the following null hypothesis was tested:

H_0: *In the population, there is no difference between graduates in an*

elementary teacher education program and graduates in a secondary teacher education programs when they are compared simultaneously on their rating on job satisfaction, their rating on knowledge of teaching, their rating on skill of teaching, and their rating on quality of the program.

Against the following alternative hypothesis:

H_a: *In the population, there is a difference between graduates in an elementary teacher education program and graduates in a secondary teacher education programs when they are compared simultaneously on their rating on job satisfaction, their rating on knowledge of teaching, their rating on skill of teaching, and their rating on quality of the program.*

Results:

Multivariate Chi-square Q-Q plots were generated for graduates in elementary teacher education programs (Elementary) and graduates in secondary teacher education programs (Secondary) by using PROC IML in the SAS statistical package and shown in Figure 1 and Figure 2. Examination of the plots indicated that most of the points are around the 45° angle passing through the origin. Hence it can be assumed that the observations are coming from a multivariate normal population. A test on homogeneity of variance-covariance matrices was performed by using PROC DISCRIM in the SAS system and the test results will be shown in Table 1. Table 1 revealed that the variance-covariance matrices for these two groups are homogeneous.

Scores of the four subscales were then analyzed using a one-way MANOVA, between-groups design in the SAS system and summarized in Table 2. This was followed by four one-way ANOVAs for four different subscales (See Table 2). The analysis in Table 2 revealed a significant multivariate effect for type of teacher education programs, Wilk's $\lambda = .99$, $F(4, 1493) = 3.34$, $p < .01$. A close examination of Table 2 showed that the Elementary program with mean = 5.08 and the Secondary program with mean = 4.96 are significantly different on Job Satisfaction, $F(1, 1496) = 4.32$, $p < .05$. Table 2 also indicated that the Elementary program with mean = 5.02 and the Secondary program with mean = 4.86 are significantly different on Program Quality, $F(1, 1496) = 10.40$, $p < .01$. Additional investigation of means on each item by type of program (Elementary and Secondary) for Job Satisfaction and Program Quality subscales were generated and summarized with output from one-way ANOVAs (See Table 3). As reported in Table 3, the means on the elementary program were found to be significantly higher ($p < .05$) for two items on the Job Satisfaction Subscale, and four items on the Program Quality Subscale ($p < .05$). In general the means for the elementary graduate were higher on 12 of the 14 items (six of which were significantly different). The two items where the secondary graduates were slightly more positive than the elementary graduates were salary and authority. The item means on the Job Satisfaction subscale ranged from a low of 4.11 to a high of 5.98. The graduates indicated greater satisfaction with students colleagues interaction and only moderate satisfaction with salary, advancement and working conditions. The item means on the Program Quality subscale ranged from a low of 3.87 to a high of 5.98. The graduates indicated greater endorsement

of their mentoring, field experience and teaching experience and lower endorsement of advice from adviser and liberal arts courses.

Discussion:

Two major assumptions of MANOVA are *multivariate normality* and *homogeneity of variance-covariance matrices.* This study assessed the normality assumption by Chi-square Q-Q plots. This study also performed an appropriate test on *homogeneity of variance-covariance matrices* and found that the variance-covariance matrices are homogeneous. Therefore, the appropriateness of the MANOVA technique applied in this study is supported.

Results of the MANOVA described here suggested that there is difference between graduates in elementary teacher education programs and graduates in secondary teacher education programs when they are compared simultaneously on their rating on job satisfaction, their rating on knowledge of teaching, their rating on skill of teaching, and their rating on quality of the program. The follow-up univariate ANOVAs revealed that the differences between graduates in elementary teacher education programs and graduates in secondary teacher education programs (favoring elementary programs) were on the subscales of Job Satisfaction, and Program Quality, at least for the fourteen institutions that are contained in the database. These results have important ramifications for the use and interpretation of data from follow-up studies of graduate of teacher education programs.

Figure 1: Chi-square Q-Q Plot for Elementary Teacher Education Graduates on the Four National Database Subscales of Knowledge, Skills, Job Satisfaction, and Program Quality.

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Figure 2: Chi-square Q-Q Plot for Secondary Teacher Education Graduates on the Four National Database Subscales of Knowledge, Skills, Job Satisfaction, and Program Quality.

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Table 1: Test of Homogeneity of Covariance Matrices for Elementary and Secondary Teacher Education Graduates on the Four National Database Subscales of Knowledge, Skills, Job Satisfaction, and Program Quality.

Chi-square	DF	p
14.479	10	.152

Table 2: Multivariate and Univariate Analysis of Variance of Elementary and Secondary Teacher Education Graduates on the Four National Database Subscales of Knowledge, Skills, Job Satisfaction, and Program Quality.

Subscale	Program	Mean	F	*p*
Job Sat.	Elementary	5.08	4.32	.037
	Secondary	4.96		
Knowledge	Elementary	2.20	0.29	.588
	Secondary	2.19		
Skills	Elementary	2.09	0.09	.766
	Secondary	2.10		
Quality	Elementary	5.02	10.40	.001
	Secondary	4.86		

Wilks' Lamda = 0.99, $F(4, 1493) = 3.34$, $p < .01$

Table 3: Univariate Analysis of Variance of Elementary and Secondary Teacher Education Graduates on items contained within the Job Satisfaction and Program Quality Subscales.

Item	Program	Mean	F	p
Salary	Elementary	4.17	0.53	.465
	Secondary	4.23		
Advance	Elementary	4.22	1.44	.231
	Secondary	4.11		
Challeng	Elementary	5.44	10.48	.001
	Secondary	5.19		
Authorit	Elementary	4.97	1.07	.302
	Secondary	5.06		
Wkcond	Elementary	4.73	0.75	.386
	Secondary	4.66		
Colleag	Elementary	5.55	3.25	.071
	Secondary	5.41		
Students	Elementary	5.98	14.44	.000
	Secondary	5.73		
Qlibarts	Elementary	4.54	1.77	.183
	Secondary	4.62		
Qpreppgm	Elementary	4.91	11.31	.000
	Secondary	4.68		
Qfieldex	Elementary	5.16	25.46	.000
	Secondary	4.75		
Qtchexp	Elementary	5.98	5.80	.016
	Secondary	5.82		
Qmentor	Elementary	5.77	6.67	.010
	Secondary	5.58		
Qadvprof	Elementary	5.04	1.36	.244
	Secondary	4.94		
Qadvadv	Elementary	3.89	0.04	.844
	Secondary	3.87		

References:

Ayres, J. B. (1979, April), Follow-up Studies: Providing the Thrust for Program Improvement, Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco: CA.

Johnson, R. A. & Wichern, D. W. (1988), Applied Multivariate Statistical Analysis, Second Edition, Englewood Cliffs NJ: Prentice Hall.

Khattree, R. & Naik, D. N. (1995), Applied Multivariate Statistics with SAS Software, Cary NC: SAS Institute Inc.

Loadman, W. E., Brookhart, S. M. & Freeman, D. J. (1989, March), Developing a National Database for Pre-service Teacher Education Follow-up Studies, Paper presented at the Annual Meeting of the American Association of Colleges for Teacher Education, Anaheim: CA.

Mardia, K. V. (1980), Tests of Univariate and Multivariate Normality, Handbook of Statistics, Vol. 1: Analysis of Variance, Ed. P. R. Krishnaiah, Amsterdam: North Holland.

Rummel, R. J. (1970), Applied Factor Analysis, Evanston: North Western University Press.

SAS Institute Inc. (1989), SAS/STAT User's Guide: Version 6, Fourth Edition, Volume 1, Cary NC: SAS Institute Inc.

SAS Institute Inc. (1989), SAS/STAT User's Guide: Version 6, Fourth Edition, Volume 2, Cary NC: SAS Institute Inc.

Stevens, J. (1986), Applied Multivariate Statistics for the Social Sciences, Hillsdale NJ: Lawrence Erlbaum Associates.